What are the Chances?

Brief Overview:

The students will develop an understanding of probability concepts by conducting investigations that help them identify the likelihood of possible outcomes. The lessons provide a variety of ways for the students to explore their understanding. In the first lesson, students make choices about which spinner will most likely give a desired outcome. The second lesson gives students an opportunity to record results from a trial onto a frequency table and create a graph using the data. The last lesson includes an opportunity to practice subtraction facts while collecting data to determine the fairness of the game.

NCTM Content Standard/National Science Education Standard:

- Describe events as likely or unlikely and discuss the degree of likelihood using such words as *certain*, *equally likely*, and *impossible*;
- Predict the probability of outcomes of simple experiments and test the predictions;
- Understand that the measure of the likelihood of an event can be represented by a number from 0 to 1.

Grade/Level:

Grade 3

Duration/Length:

3 days (60 minutes daily)

Student Outcomes:

Students will:

- Identify possible outcomes that make up the sample space for a given real life situation.
- Identify possible outcomes for a given experiment.
- Describe the probability of an event using words.

Materials and Resources:

Lesson 1
- "Is It Likely?" Teacher Resource 1A and 1B
- "Probability Number Line" Student Resource 1
- Directions for "Spinning Soccer Game" Teacher Resource 2

- Game board for "Spinning Soccer" Student Resource 2
- Spinners for "Spinning Soccer" Student Resource 3
- "Spinning Soccer Recording Sheet" Student Resource 4
- "Spinning Soccer Game: Reflection" Student Resource 5
- "Spinning Soccer Spinners" Student Resource 6
- Paper clips and pencils for spinners
- Index cards
- Large open ended number line

Lesson 2
- "Warm-up Spinners" Teacher Resource 3
- "Probability Number Line" Student Resource 1
- "Frequency Table for Drop the Cup"   Student Resource 7
- Small paper cups for each pair of students

Lesson 3
- Pair of dice for each pair of students
- "Is the Game Fair?" Student Resource 8
- Exit ticket Student Resource 9

Development/Procedures:

Lesson 1
Pre-Assessment/Launch
- Determine students' understanding of the terms more likely, less likely, equally likely, certain and impossible by creating a large number line. It should be labeled 0 at the beginning for impossible and 1 at the end for certain. If desired, you can label the center as ½.
- Give select students index cards labeled "more likely", "less likely", "equally likely", "certain", and "impossible".
- Ask students to reflect on the likelihood that they will have homework tonight.
- Have these students place the cards on the large number line in the appropriate place on the number line.   Using Every Pupil Response, see if other students agree or disagree.
- Arrange students into groups and have them judge various events as more likely, less likely, equally likely, certain, and impossible by placing the letter of the event on the number lines at their seats (Teacher Resource 1A, 1B, and Student Resource 1).

Teacher Facilitation/Student Application
- Tell students that they are going to play a probability game in which they determine the likely results of different spinners (Teacher Resource 2).
- Show the "Spinning Soccer" game board (Student Resource 2) and the Spinners (Student Resource 3) on the overhead. Students will play in pairs using only one spinner each round.

What are the Chances?   2

- Demonstrate the game as you explain the rules. The students will advance the chip one line towards the color goal that is spun. For example, if one student spins a blue, then the chip will be moved one line toward the blue goal. Play continues until the chip is behind a goal.
- Give students the "Spinning Soccer Recording Sheet" (Student Resource 4) and have them predict which spinner will give yellow the best chance of winning.
- Students play a game with Spinner A and record the outcome. Then continue to play and record the outcome with Spinner B followed by Spinner C.
- After students have played a game with each spinner, have them pause for whole group discussion. Collect data about each spinner from the groups. Record the results. Ask: "Which spinners gave the result they wanted?" Were all the spinners fair? Which spinners were more likely to produce a blue winner? Which spinners were more likely to produce a yellow winner?
- Now, students may play the game with all three spinners. Students may choose a different spinner at each turn as they develop a strategy to have their color win.

Embedded Assessment

Have students demonstrate their understanding by completing Student Resource 5.

Reteaching/Extension
Have students play the same game using the spinners from Student Resource 6.

Lesson 2
Preassessment/Launch
- Using the number line from the day before, have the students place spinners with different sized options on the number line to show more likely, less likely, equally likely, impossible, and certain outcomes. Divide the class into two groups. One group has the outcome of "yellow" and the other group has the outcome of "blue". Have them place the letter of the spinner on the "Probability Number Line" that would show more likely, less likely, equally likely, impossible, and certain for their outcome. See Student Resource 1 and Teacher Resource 3.
- Discuss with the students the reasons the "Probability Number Lines" looked different for each group.
- Ask follow up questions: "What is the probability of spinning a green?" "What would happen if one spinner was all blue?"

Teacher Facilitation/Student Application
- Show the students a small paper cup. Ask the students to predict how the cup would land if dropped. Ask the students to predict how many times the cup

would land upside down, right side up or on its side if it were dropped 100 times. Ask students to justify their predictions.
- Demonstrate dropping the cup and record the result on the frequency table (Student Resource 7).
- Give pairs of students a small paper cup. Ask them to drop the cup 20 times and record their results on the frequency chart.
- Bring the class back together and collect the data from the groups on a frequency chart on the overhead.
- Model the steps for creating a bar graph on the overhead using the class data. Have students create a bar graph using their data and compare their predictions to the trials and to the class results.

Embedded Assessment
Have students write in their journals what they discovered from this trial.

Reteaching/Extension
Conduct the trial in the same way using polyhedron die and compare the results with the results from the cup trial.

Lesson 3
Pre-Assessment/ Launch
- Have students work in small groups and think what makes a game fair or unfair. Students write responses on chart paper and share with the class.
- Record their ideas on chart paper.

Teacher Facilitation/Student Assessment
- Tell the students they are going to gather data to determine the fairness of the dice game called "Is the Game Fair?" (Student Resource 8a-b).
- Students are grouped as partners and roll two dice 20 times. After each roll, the students find the difference and record their answers on a student created frequency table. Model how to design the frequency table for the students.
- Using this information, students will analyze the fairness of the games played by Kevin and Sue. (Student Resource 8) Note to teachers: Sue will most likely win the game most often because there are more possible outcomes for 0, 1 and 2 than for 3, 4, and 5. There are 6 possible outcomes for a difference of 0; 5 possible outcomes for a difference of 1; 4 possible outcomes for a difference of 2; 3 possible outcomes for a difference of 3; 2 possible outcomes for a difference of 4 and 1 outcome for a difference of 5. There are 0 outcomes for a difference of 6.
- After the students have played the game several times, pause to discuss the results. Ask the students: "What did you notice about who won the game most often?" "What could have been done to make this game fair for Kevin?"

Embedded Assessment

Check for student understanding using the Exit ticket (Student Resource 9).

Reteaching/Extension

Assign point values to the dice without having the students subtract.

Summative Assessment:

Students will complete the probability assessment (Student Resource 10).

Authors:

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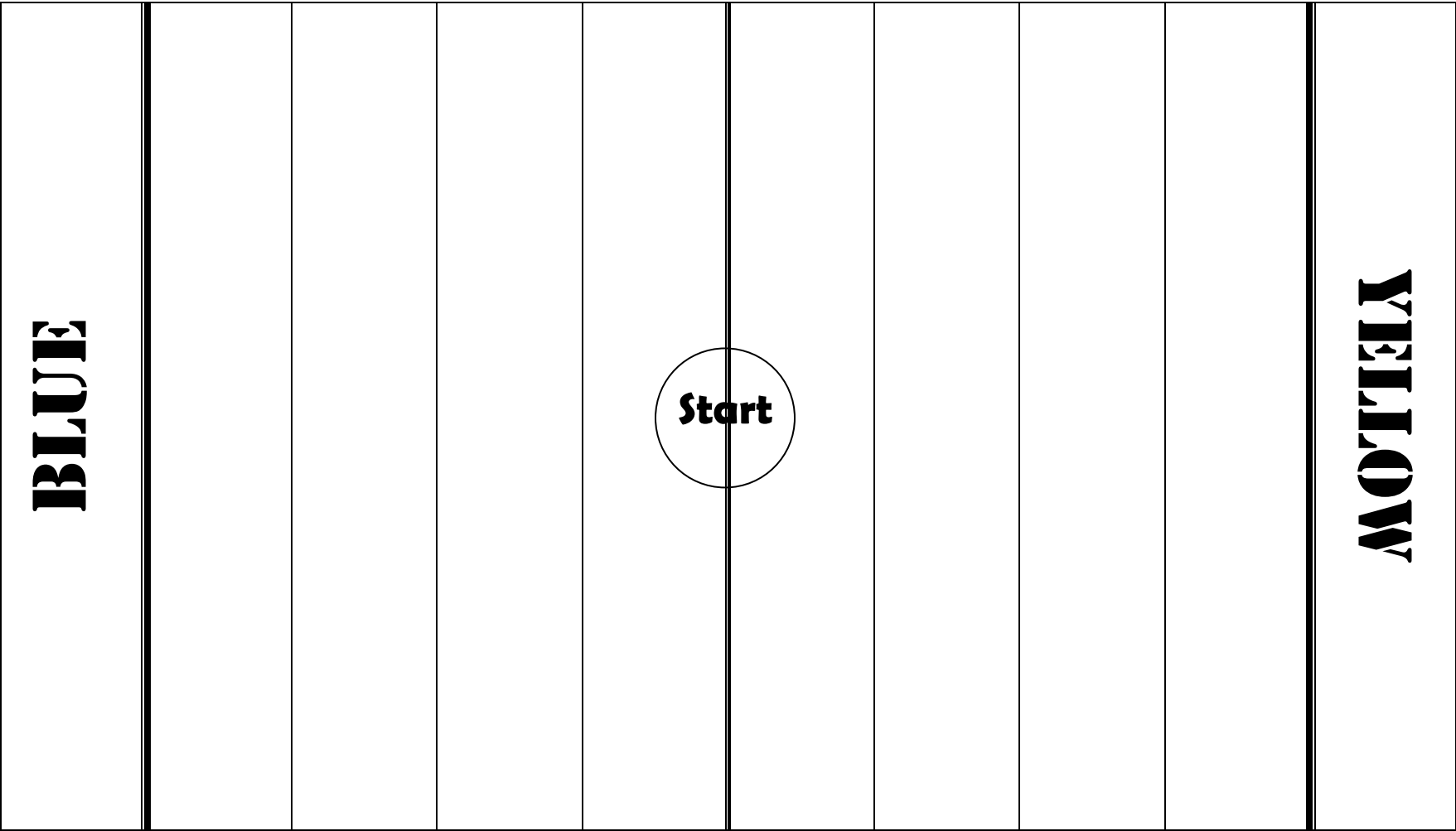School: Laurel Woods Elementary
County/Jurisdiction: Howard

Probability Number Line

0 ═══════════════════════════════════════ 1

Cut the letters out and place on the number line.

A	B	C	D	E	F	G

Spinning Soccer

BLUE

Start

YELLOW

SPINNING SOCCER SPINNERS

Spinner A

YELLOW | BLUE

Spinner B

YELLOW

BLUE

Spinner C

BLUE
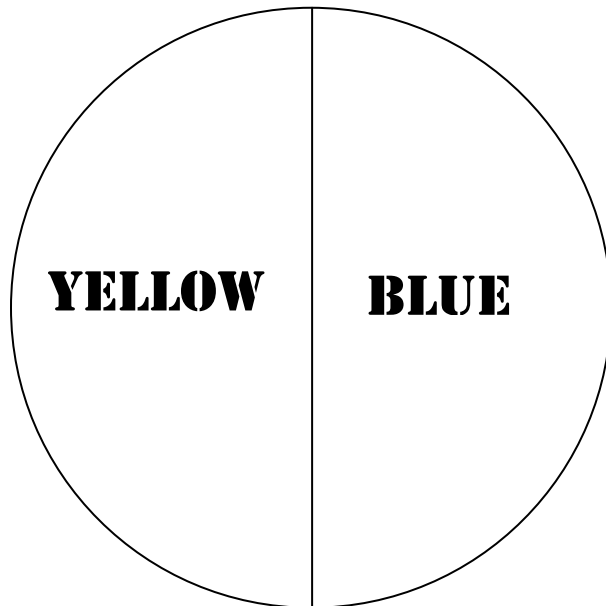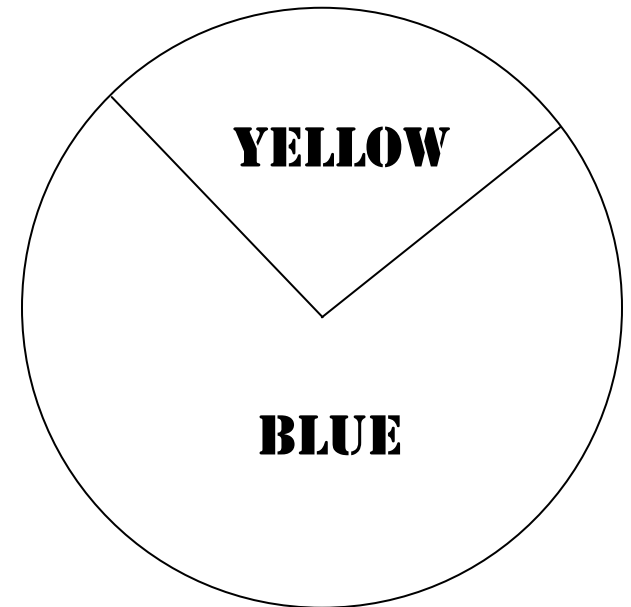
YELLOW

Spinning Soccer Recording Sheet

Name:_____

Predict:

In this game, which spinner gives yellow the best chance of winning? _____

Try it!

Spinner A	Spinner B	Spinner C	Use all
Prediction:	**Prediction:**	**Prediction:**	**Prediction**
Outcome: Which color won the game?	Outcome: Which color won the game?	Outcome: Which color won the game?	Ou Which c g

Name_____ Date_____
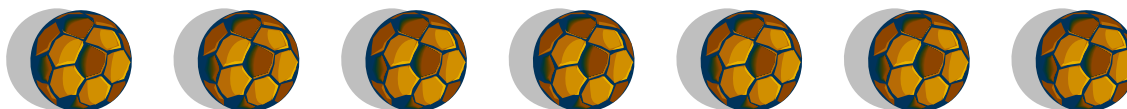
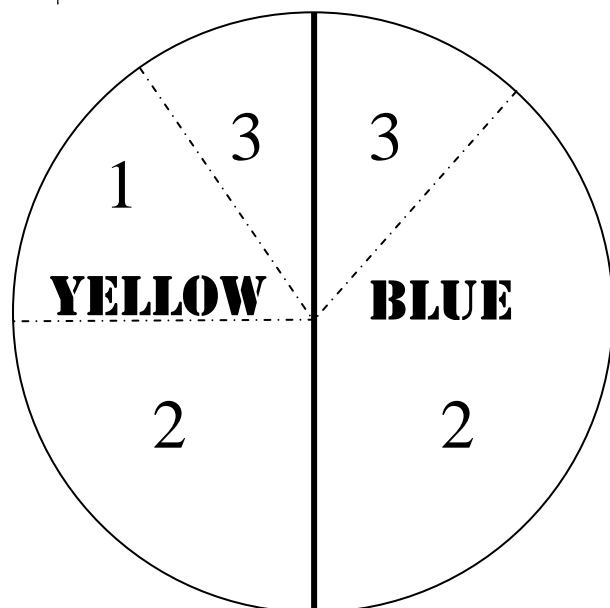## Spinning Soccer Game
Reflection

A. If the player with the yellow goal won the game, which spinner do you think he used?

(Be sure to use what you discovered about the results of the Spinning Soccer Game.)

_____

B. Use the terms less likely, more likely, and equally likely, to explain your thinking.
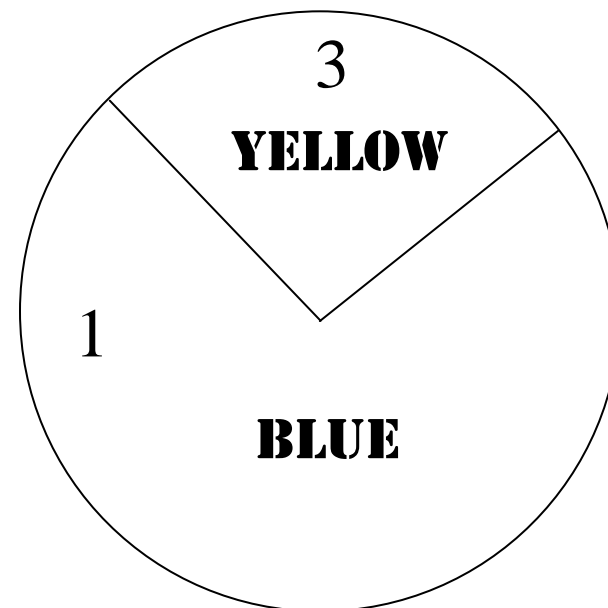
_____
_____
_____
_____
_____
_____

SPINNING SOCCER: SPINNERS

Spinner A

3   3

1

YELLOW   BLUE

2   2

The numerals 1,
2, and 3
indicate the
number of
spaces to move.

Spinner B

3

YELLOW

1

BLUE

Spinner C

BLUE

3

1   2

YELLOW
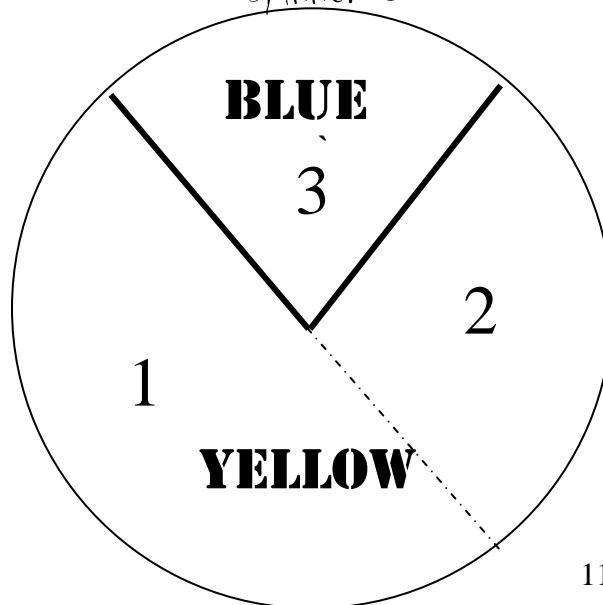
Frequency Table for
Drop the Cup

	Prediction	Actual number of times
Upside Down		
Right Side Up		
On the side		

Name_____ Date_____

"Is the Game Fair?"

Kevin and Sue were playing a game with dice. Each player tossed two dice and subtracted the larger number from the smaller number. A point was given to Sue if the difference was 0, 1 or 2. Kevin was given a point if the difference was 3, 4 or 5. The dice were rolled twenty times.   Sue says she will most likely win the game. Work in pairs to determine if Sue is correct.

Predict who will win the game. _____

<u>Directions</u>:
1. Take turns rolling the dice 20 times.
2. Subtract the smaller number from the larger number.
3. Record the results on the lines below.

_____

_____

Record the outcomes in the frequency chart using tally marks.

Difference	Number of times the difference occurred
0	
1	
2	
3	
4	
5	

Using the data from your frequency table, assign point values to Sue and to Kevin.

1. **Sue earned a point each time the difference was 0, 1 or 2.**

   How many points did Sue earn?_____

2. **Kevin earned a point each time the difference was 3, 4 or 5.**

   How many points did Kevin earn?_____

2. **Decide who won the game.**

   Explain._____

   _____

   _____

Name_____

Name 2 things you learned from today's lesson:

_____

_____

_____

_____

_____

Is It Likely?

Ask students to judge various events as **certain**, **impossible**, or **possible** (might happen). Place the letters on the number line.

A. It will rain tomorrow.
B. Drop a rock in water, and it will sink.
C. Trees will talk to us in the afternoon.
D. The sun will rise tomorrow morning.
E. Three students will be absent tomorrow.
F. George will go to bed before 8:30 tonight.
G. You will have two birthdays this year.

Is It Likely?

Ask students to judge various events as **certain**, **impossible**, or **possible** (might happen). Place the letters on the number line.

A. You will win a million dollars.
B. You will get the flu this year.
C.   Coin you flip will land on heads.
D. It will snow this year in Colorado.
E. We will see two suns in the sky.
F. It will snow in May.
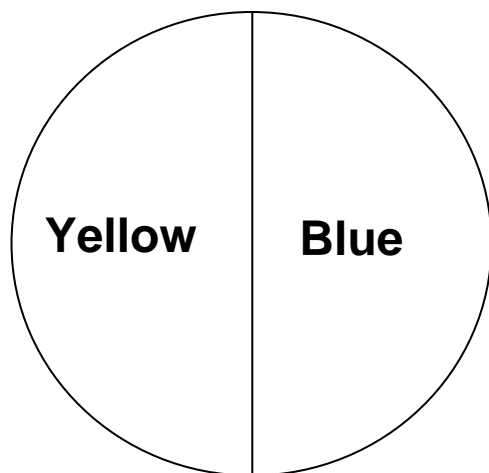G. We will have homework.
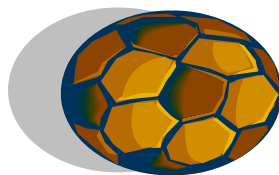
Spinning Soccer Game

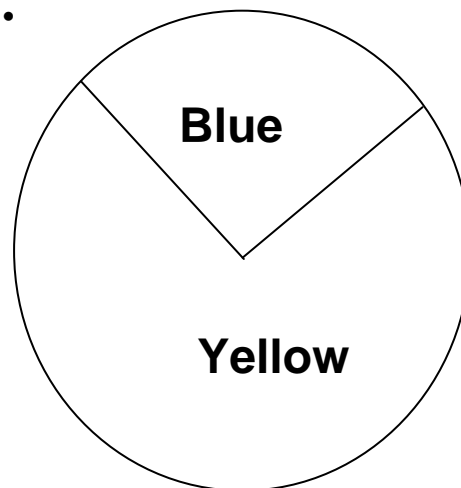Purpose of the game is to get the chip behind the goal.

Directions:

1. Students will work in pairs.
2. Place the chip in the middle of the game on start.
3. Use spinner A and take turns spinning.
4. Move the chip one space toward the goal that comes up on the spinner.
5. Play continues until the chip is behind a goal.
6. Start a new game with spinner B and then spinner C.

7. Now, play the game using all three spinners.
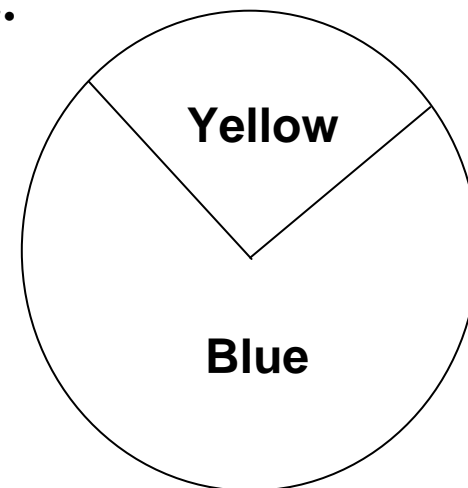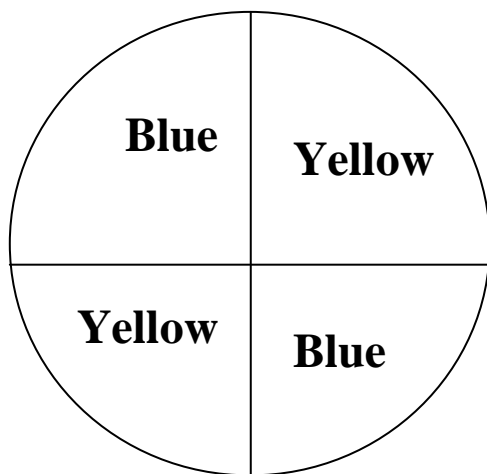
Warm-Up Spinners

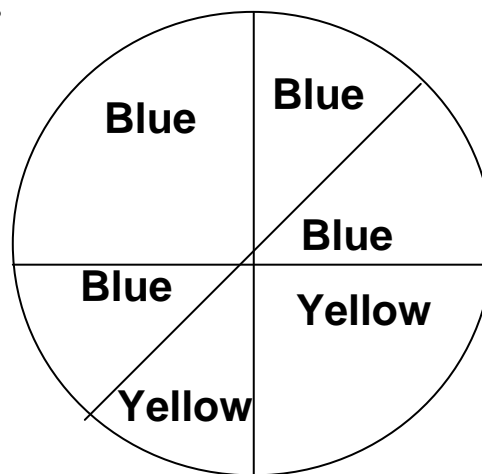**A.**

Yellow | Blue

B.

Blue

Yellow

C.

Yellow

Blue

D.

Blue | Yellow

Yellow | Blue

E.

Blue | Blue

Blue

Blue | Yellow

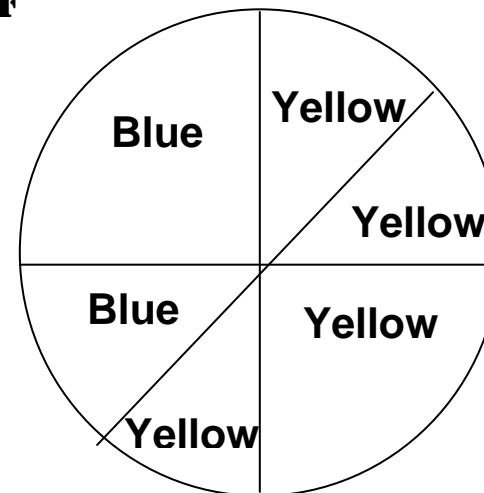Yellow

F

Blue | Yellow
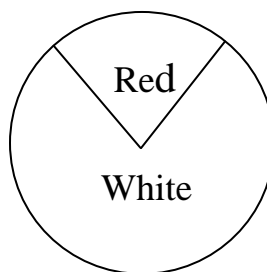
Yellow

Blue | Yellow

Yellow

Name_____ Date_____

Probability Assessment

A. A spinner is divided into areas labeled red and white, as in the diagram below.

Spinner

1. If you were to spin the spinner, would you be just as likely to obtain red as white? Explain your thinking.

_____

_____

_____

_____

_____

2. Are you **certain** of getting at least one red in 100 spins? Why or why not?

_____

_____

_____

_____

_____

_____

B. Kathy and Sam wanted to play the "Is it Fair Game?" Kathy and Sam subtracted the smaller number from the larger number after rolling two standard six-faced dice twenty times. Kathy received one point if the difference was 2 or 4. Sam received a point if the difference was 1, 3 or 5. Here are the results from the experiment.

Rolls	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Kathy		1	1						1		1	1				1		1		1
Sam	1			1	1	1	1	1		1			1	1	1		1		1	

Insert the data on the frequency table.

Names	Tallies

Do you think this was a fair test? Explain how you know by showing all possible outcomes.

_____

_____

_____

_____

_____